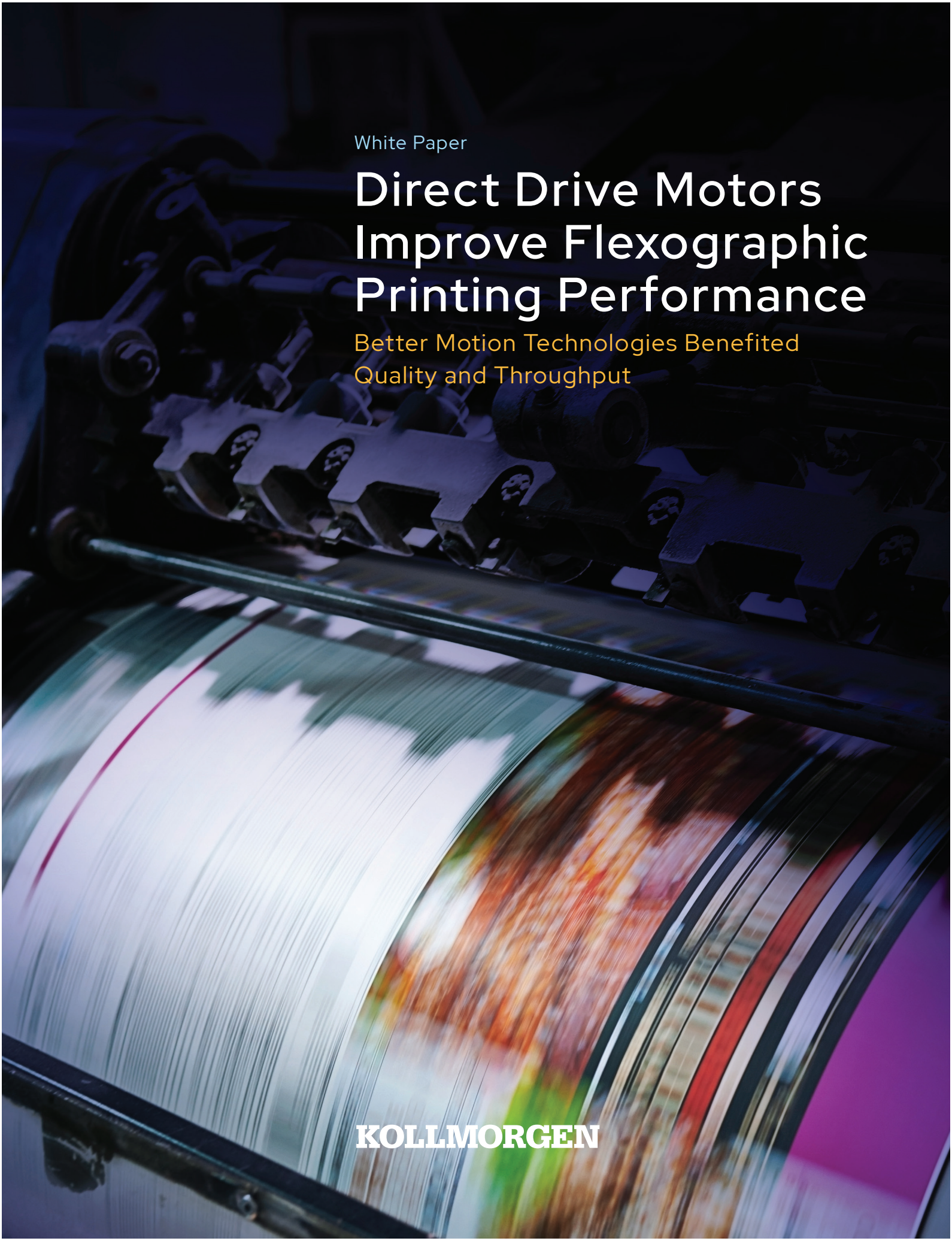


White Paper

Direct Drive Motors Improve Flexographic Printing Performance

Better Motion Technologies Benefited Quality and Throughput

KOLLMORGEN

Replacing mechanical transmission with direct drive motors saw performance gains in speed, output and quality.

Technology has advanced significantly in flexographic—or flexo—printing, specifically the use of higher quality inks, printing plates and machines. Yet the same challenges still persist: the need to obtain a steady repeat length while managing the varied tensions as reels change diameter during production. Throughout the printing process all servo motors for a multi color machine need to work in harmony to ensure the accurate registration during high speed running to produce a high-quality product that is correctly printed and precisely wound.

Recent work done by Kollmorgen—a global leader in manufacturing motor and motion solutions—has shown that it is possible to synchronize components within the flexo printing process without mechanical transmission by using closed loop control technology. This synchronization is key to managing web tension throughout the process while ensuring a steady repeat length.

FLEXOGRAPHIC PRINTING

Flexographic printing is a two-phase rotary printing process where quick-drying inks are transferred from flexible printing plates to a substrate. There is the prepress, where the printing preparations are made, and the printing stage, where the plate sleeves are mounted on the printing machine and the ink is pumped into the inking system. Flexo printing has several advantages including the ability to quickly change designs, speed of the production process and higher throughput. However, it requires tension, motion control and synchronization across the whole process, and inaccuracies or inconsistencies in the run can be timely or costly to fix.

SYNCHRONIZING COLOR WITH CLOSED-LOOP TECHNOLOGIES

Constant ink coverage is critical to flexographic printing, and accurate synchronization of the anilox roller and plate cylinder used in each print deck module has a direct impact on print quality. If the plate cylinder moves faster than the anilox roller, less ink is transferred, resulting in a light section. If it moves slower, the opposite happens. This synchronization has traditionally been accomplished by gearing the anilox roller and plate together and driving them with a single AC induction motor or by using separate servo motors to drive each axis through gearboxes. However, as press speeds and printing quality requirements increase, geared systems experience backlash, which causes the roller and cylinder to accelerate or decelerate as the gear teeth bounce back and forth. This becomes a limiting factor, introducing inaccuracies and limiting how fast a press can be pushed.

Kollmorgen developed a closed-loop system that synchronized the anilox and plate cylinders by driving each one individually using an independent, direct-drive (DDR) servo motor. This provides a higher level of accuracy by eliminating the mechanical transmission and replacing it with an all electrical system. The anilox and plate cylinders are synchronized in speed and phase, ensuring every point around the surface of the anilox roller is synced with the plate cylinder for correct ink transmission.

With closed-loop control technology, speed control and phasing between the anilox and plate cylinder can be closely controlled in the absence of gear backlash. A high-resolution and highly accurate encoder provides servo motors with far more accurate position and velocity information and a motion profile defines the operation of each servo motor. The latest generation of servo controllers provide resolution feedback up to 27 bits with 64-bit positioning resolution and 125msec position loops, 62.5msec velocity loops and 0.67msec current control loops.

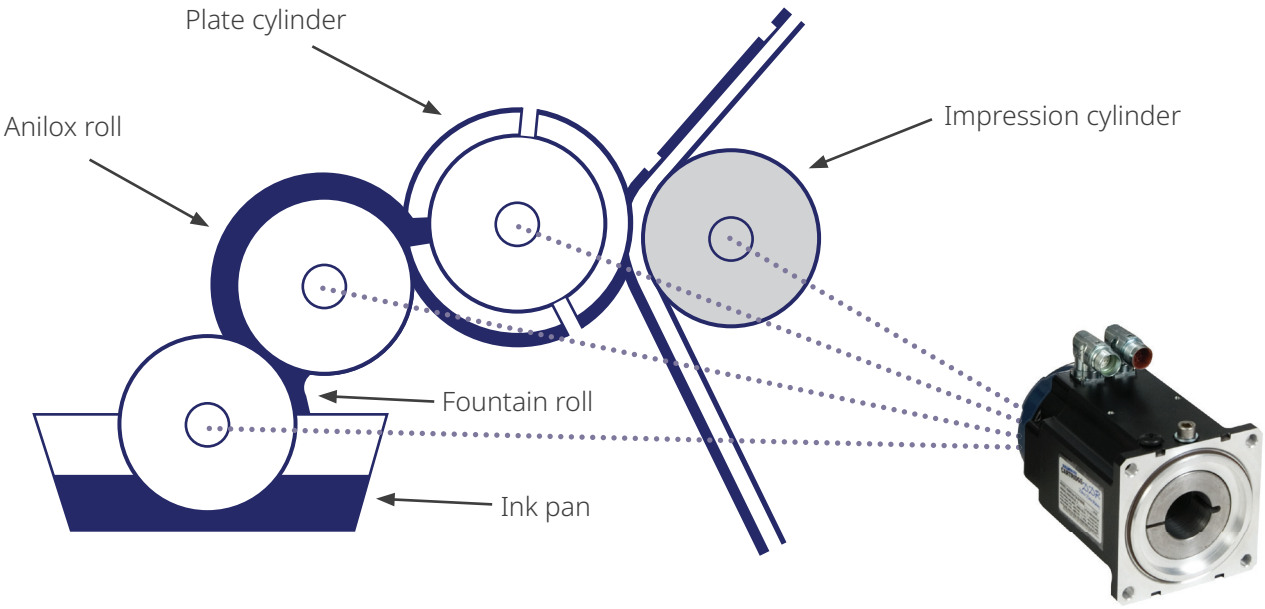
Closed-loop servo motors with controlled commutation are not prone to de-synchronization issues and torque losses. The servo system also maintains a linear and predictable speed torque curve without the need for special commutation sequences or anti-resonance control.

SWITCHING TO DDR IMPROVES ACCURACY

A direct-drive rotary (DDR) system replaces a bull gear or gearbox with a direct drive that attaches directly to the load.

This reduces set up time with fewer gears, requiring less maintenance and downtime to repair or replace. It also eliminates inaccuracies from gear backlash and wear. Moving from a traditional mechanical transmission system to a DDR system introduces several performance and maintenance advantages:

- DDR systems offer accuracy of about +/-25arc seconds—up to 20 times higher than conventional geared systems.
- Anilox and print cylinders driven by a geared system are more difficult to separate the two axes for maintenance and exchange of printing sleeves or plates.
- Direct drive anilox, plate and CI drums can move independently of each other for more control over the movement as well as easier maintenance, cleaning and changing of plate blankets.
- DDR removes the need for alignment, lubrication and part replacement of the mechanical transmission system.

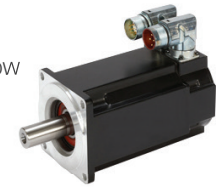


CHOOSING THE RIGHT MOTOR SIZE AND FRAME

DDR motor size can be based on the peak torque required for achieving the desired acceleration time specifications. With direct drives, inertia mismatch of 250 to 1 is common and mismatch of 800 to 1 has been implemented. In many flexo presses, the size of the motor is dictated by the inertial matching requirements. And since the direct-drive motor is directly connected to the machine, inertia-matching is not required as it is on a conventional servo motor with gears.

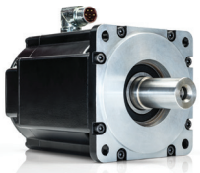
When it comes to selecting the right DDR motor for the flexo application, it's important to look at the needs of the system and match that with the designed performance of the motor. Kollmorgen tested three of its motors in the application and saw various performance changes.

- The AKM motor offers exceptionally low cogging and low harmonic distortion to ensure smooth performance.



- A cartridge direct drive rotary (CDDR) motor connects directly to a load to provide up to 50% more torque density than comparably sized servo motors.

- The AKM2G has more torque than comparable servo motors in a smaller footprint along with several feedback options to match performance and application requirements, including advanced safety options.



In addition to the types of motors, there were also various housings that were implemented. Depending on the machine setup, the motor might need to be mounted with a particular housing.

- Frameless is expensive to fully integrate and service because they are embedded. High upfront costs but with higher performance and higher quality and able to fit in smaller spaces
- Full frame integrates all components of a motor including the stator, rotor, bearings and feedback device within a housing. Reduces development cost. Needs to make sure the motor's and machine's bearings must be precisely aligned, which is a time-consuming task. Improper alignment can cause premature bearing failure.
- A cartridge DDR (CDDR) servo motor is fully housed with no bearings and uses the host machine to support the motor's rotor. It's easy to use and setup in applications that have bearings, like printers where rollers have heavy-duty precision bearings. It has high upfront cost but can eventually reduce operating costs by up to $10,000 per motion axis.

MANAGING TORQUE FOR EVEN SPEED

There is a tech challenge with the system: the constant spin of the anilox roller and the flexoplate roller. Any accelerating and decelerating that is going up and down you cannot control the ink. It's important to keep speed consistent among the stations. If a flexo has ink on one side but not another, it can change the torque and speed of the roller, which needs to be adjusted with speed controls. Traditional systems use bigger motors with high inertia where changes in the ink wouldn't make much difference to the speed of the large motor.

Using a standard rotary motor with a gearhead, which reduces the speed of the motor, the rotary motor needs at least 40Nm of rms torque to keep the system running at an even speed. However, by the time it reaches the flexo it is only around 5Nm. A lot of that energy is lost in the mechanical transmission process. By removing the motors and gearhead and putting in direct drive, Kollmorgen was able to supply 5Nm instead of 40Nm. This resulted in fewer components being used in the machine.

Start Your Design with Kollmorgen

By using one of Kollmorgen's DDR, AKM or AKM2G motors vs. a geared press (or even a gearless press) system can provide a printing company with better performance, increased cost savings and faster time to market. But this is just the start. Kollmorgen employs a whole system approach for an integrated environment: motion control, machine automation, I/O and HMI, including graphical programming and real-time analysis. Kollmorgen makes it easier to set up and get running for a shorter time to market while also providing greater quality control throughout the printing process.

For Answers, Partner With Kollmorgen

Kollmorgen is more than a supplier. We're a partner, dedicated to your success. We give you direct engineer-to-engineer access to the designers who create our motion systems and who understand how to address specialized printing machine requirements. Our self-guided design tools help you model, choose and optimize products online. And with our global footprint of manufacturing, design, application and service centers, you always have access to dependable supply, co-engineering expertise, and personalized support that no other partner can provide. Whether you're upgrading an existing machine or designing the next-generation machine that will define the state of the art for your customers, we can help you engineer the exceptional.

Ready to discover all your machine is capable of? **Visit https://www.kollmorgen.com/flexography**

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